

Agency Comment History

Evaluating and
Predicting Risk

Document Name

Date

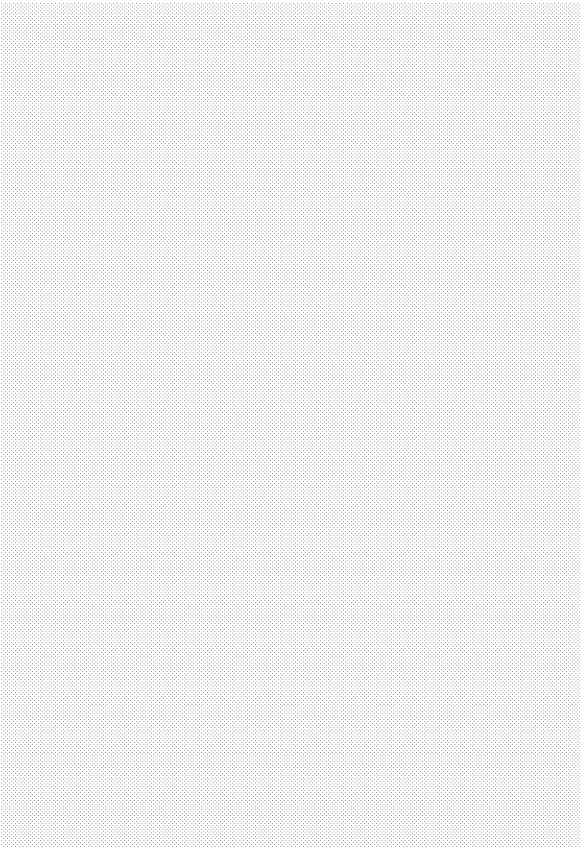
Regulatory Agency Comments on
Recently Submitted Derivative
Deliverables

12/20/2017

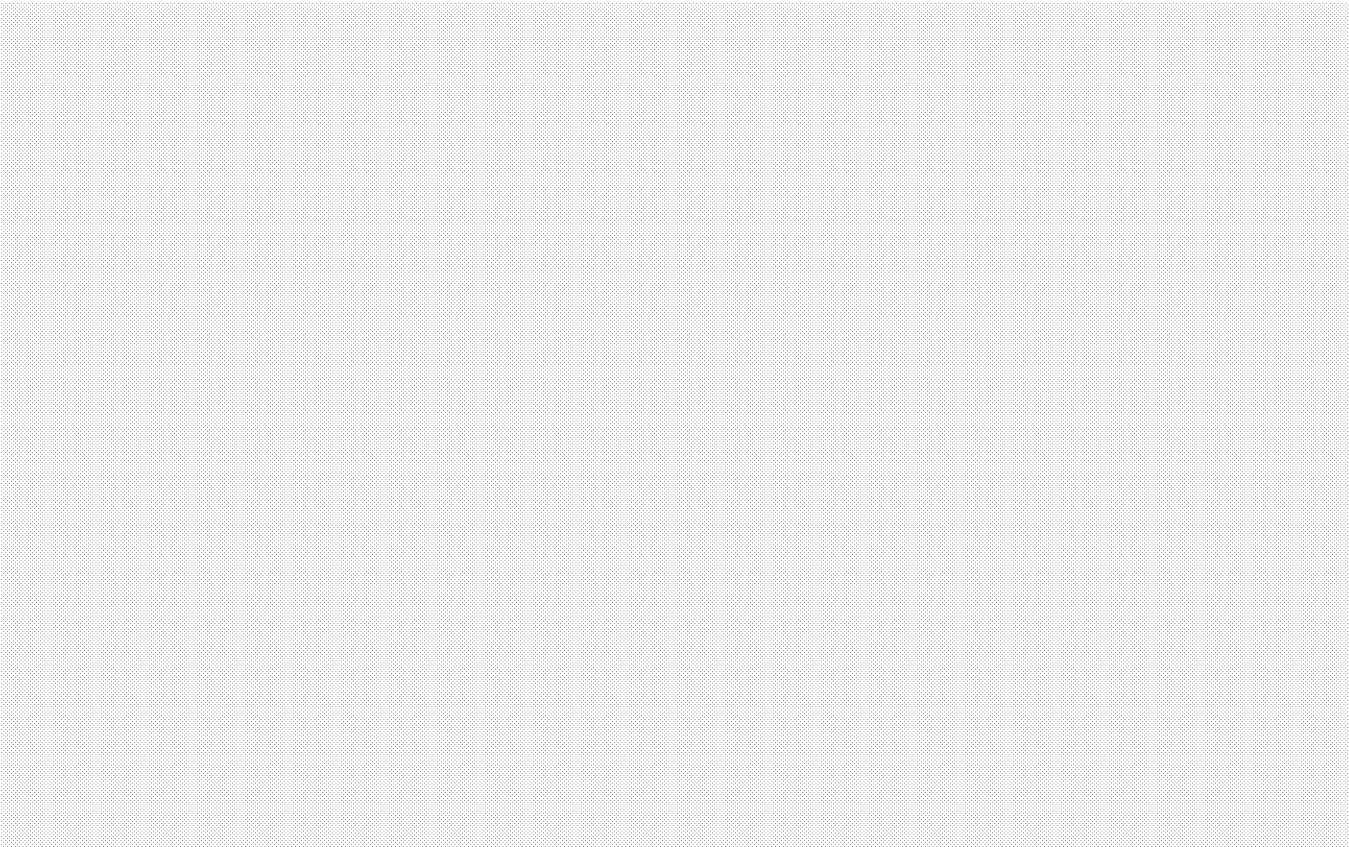
The CSM Development Plan does not discuss uncertainty. In previous discussions with the Navy, the Regulatory Agencies had stressed the importance of developing a hypothesis, providing backup data to support the hypothesis, and discussing uncertainty with respect to the Navy's future conclusion.

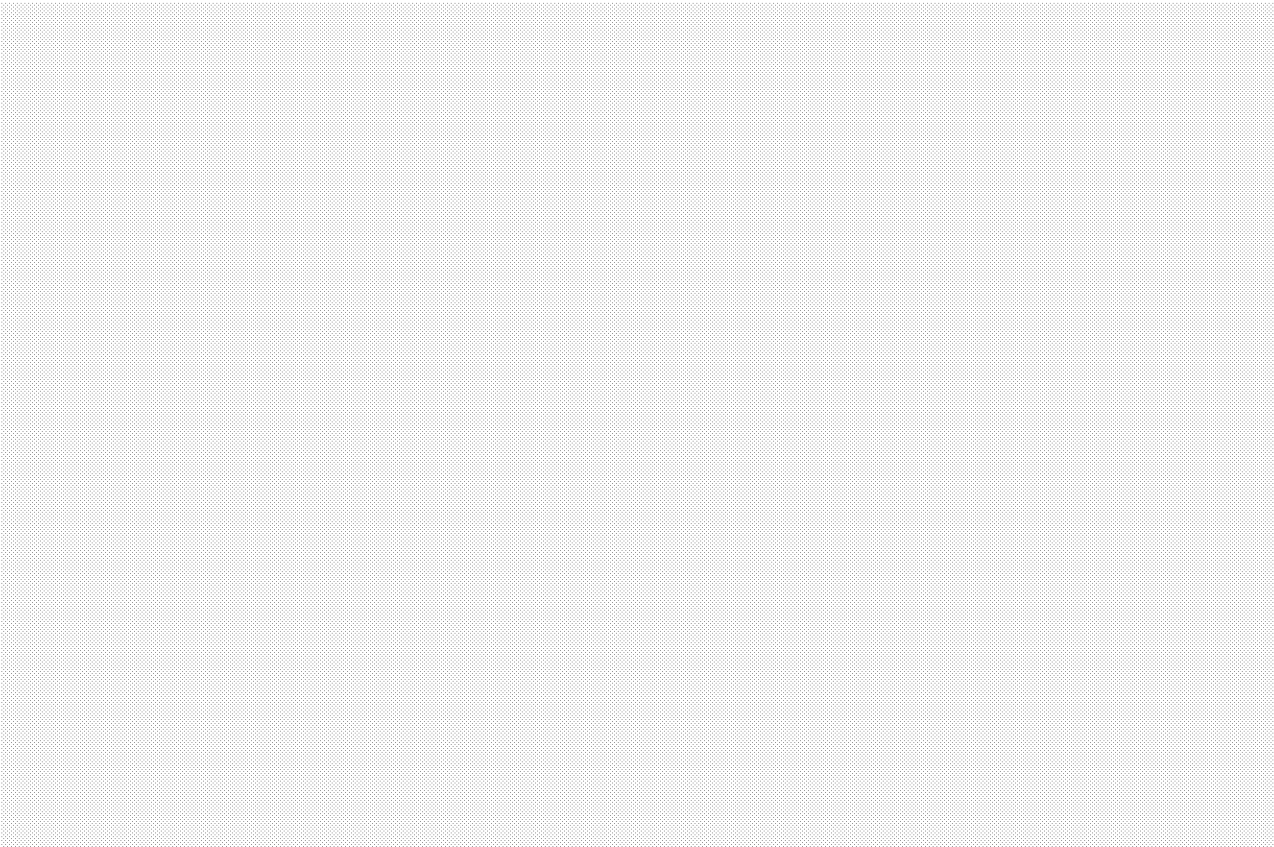
For example, preferential pathways such as lava tubes or fractured bedrock are an important uncertainty to acknowledge as unmapped fractures, lava tubes, and clinker zones could cause contamination and light non-aqueous phase liquid (LNAPL) to migrate in unexpected ways. The Regulatory Agencies understand that it is difficult to accurately map these preferential pathways, therefore the uncertainty they add to the modeling process can be significant.

Petrophysical testing



Contaminant Fate and Transport Integration





We recognize that CO₂ is a product of natural attenuation. However, the prospects for a successful CO₂ flux test are very minimal. The ground surface is separated from the zone of contamination and the water table by hundreds of feet of permeable basalt. Air moves freely through the basalts as observed by Steams when watching the blasting to excavate a water development tunnel (Steams, 1985) or the observations of the USGS at the fractured rock at Yucca Mountain, Nevada (Thortenson et al., 1989). This air exchange will likely dilute and CO₂ signal below any useful concentration for flux analysis. Also, the tunnels in Red Hill have positive ventilation pressures making and CO₂ flux measurements inside of the tunnels meaningless.

Comments on Ongoing Work to Satisfy the Red Hill Bulk Fuel Storage Facility ("Facility") Administrative Order on Consent ("AOC") Statement of Work requirements 7.1.3 (Groundwater Flow Model Report) and 7.2.3 (Contaminant Fate and Transport Report).

2/23/2018

The primary goal of the modeling effort in progress by the Navy and its consultants should be to develop tools that help evaluate and predict the risk posed to groundwater and drinking water sources from past and potential future releases from the Facility. As with any groundwater modeling effort, the utility of the developed models to support decision making relies on both the quality and resolution of data used to develop the models and the rigor and performance of the calibration.

June 6 and 7, 2018 Meetings for Red Hill Administrative Order on Consent ("AOC") 6/21/2018

The Navy and its consultants appear to be drawing conclusions prematurely about key aspects of the model that strongly influence groundwater flow and contaminant fate and transport, well before the development and calibration of the interim model has been completed and reviewed.

Characteristics of the underlying conceptual site model presented by the Navy and its consultants are not sufficiently supported by data collected at the site. The Navy and its consultants have not presented a strategy or framework for evaluating the uncertainty associated with results obtained from the model.

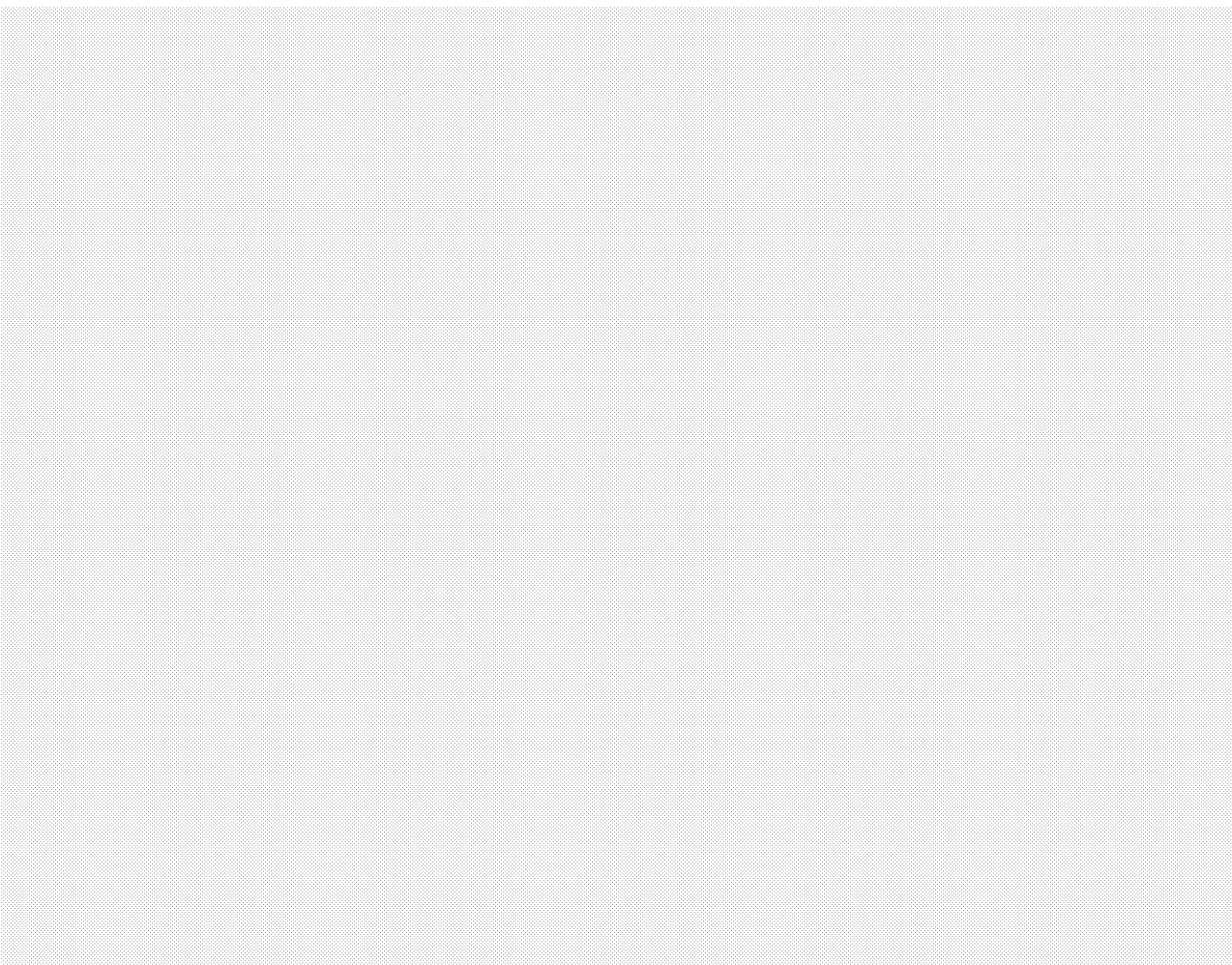
The Navy and its consultants have not presented a strategy or framework for evaluating the uncertainty associated with results obtained from the model.

Consider expanding the ability to collect data more frequently at existing monitoring wells and implementing multi-sensor tools for simultaneous collection of multiple groundwater parameters. This can provide additional data in existing monitoring locations and with minimal delay to assist with the development of groundwater models.

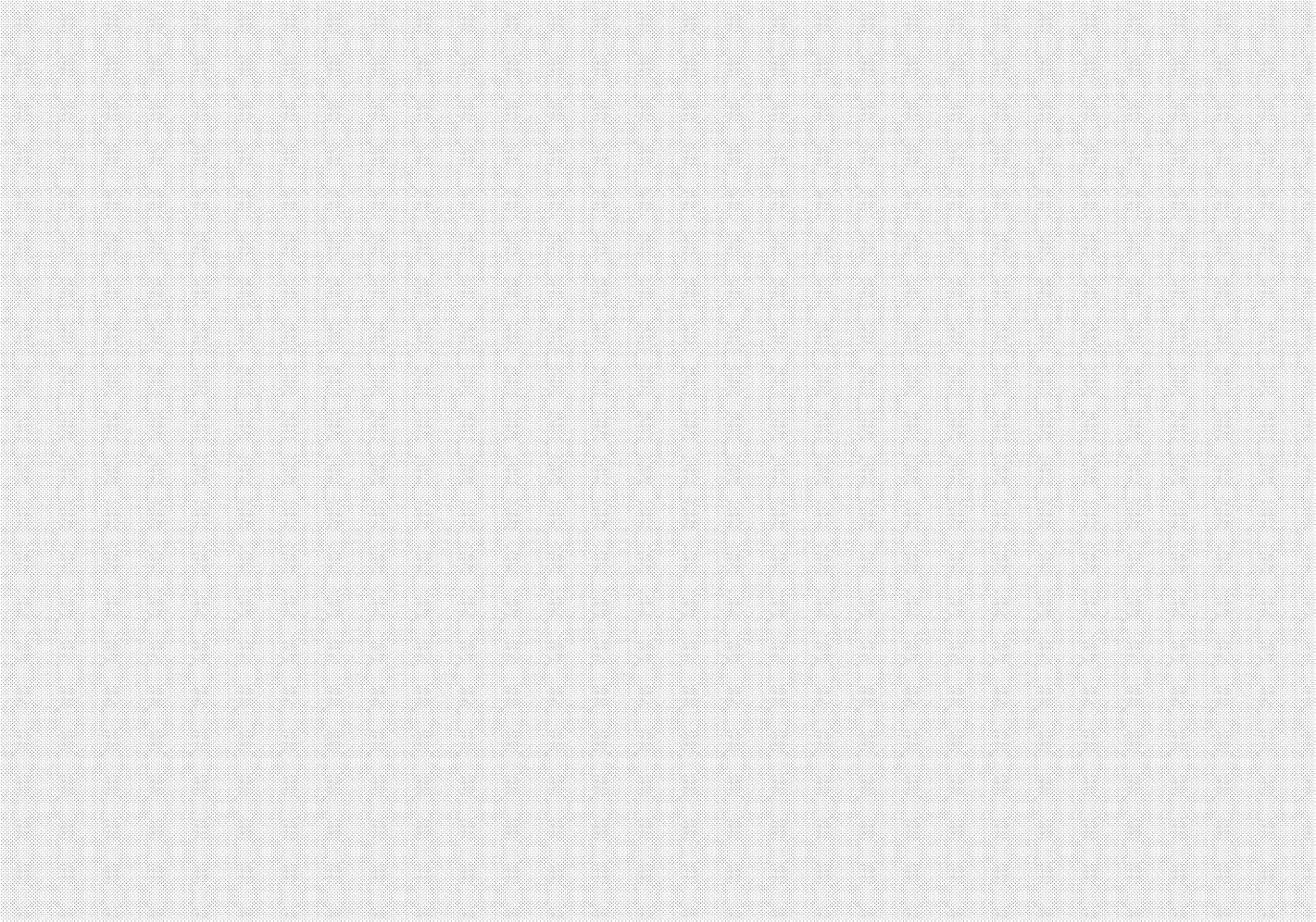
Data density limitations continue to inhibit the Navy and DLA's ability to simulate flow and transport at a scale relevant to critical upcoming decisions. The Navy and DLA should strive to collect more environmental data and expand its limited monitoring well network. Given the challenging deadlines ahead, the Navy and DLA may want to consider validation of their model through alternative methods, such as i) using existing known features, such as Red Hill and Halawa shafts, to test aspects of the groundwater flow model and ii) initial runs of a transport model that will support some of the groundwater flow model's assumptions.

The Navy and its consultants' current approach to simplifying the hydro-stratigraphy within the interim model may not render a conservative evaluation of potential groundwater flow and contaminant migration.

The Navy and its consultants' initial analysis of Non-Aqueous Phase Liquid transport, fate and transformation in the unsaturated zone is not likely conservative and appears to be inconsistent with data collected at the site.



Although we acknowledge that some inconsistencies exist in 4
the petroleum-related sampling data measured prior to the
January 2014 release from Tank 5, the Regulatory Agencies
believe the Navy and DLA's analysis should evaluate the
historical record of detections, though below health or
environmental action levels, as potential evidence for the
transport of contaminants.



Presentations related to natural source zone depletion do not appear to thoroughly address all monitoring data. Estimates for natural source zone depletion do not account for the effects of possible historic releases or alternative contamination migration pathways. Although we acknowledge that some inconsistencies exist in the petroleum-related sampling data measured prior to the January 2014 release from Tank 5, the Regulatory Agencies believe the Navy and DLA's analysis should evaluate the historical record of detections, though below health or environmental action levels, as potential evidence for the transport of contaminants.

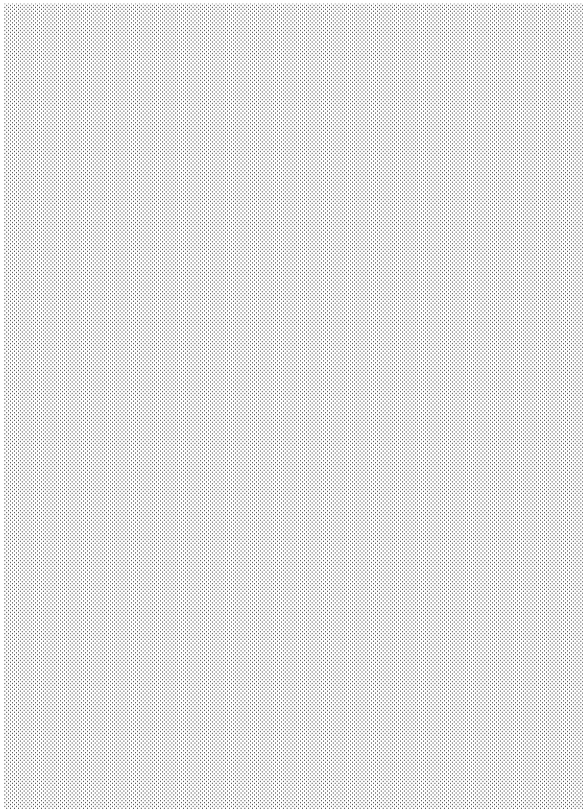
Approval to revise schedule for deliverables 6.3- Investigation and Remediation of Releases Report and 7.1.3. - Groundwater Flow Model Report of the Red Hill Administrative Order on Consent ("AOC") Statement of Work ("SOW") and Comments on Interim Environmental Reports

The Regulatory Agencies fully expect the Navy to utilize this extension to correct the deficiencies in the conceptual site model ("CSM") and groundwater flow model ("GFM") outlined in this letter and explained more fully in the enclosures.

The Regulatory Agencies continue to believe that some of the interpretations and determinations made in the interim documents are premature or inappropriate after reviewing the supporting data and conducting independent analyses. During in-person meetings of August 14- 16, 2018, the Regulatory Agencies' consultants gave a presentation on issues of concern related to the interim information that had been made available at that time.

The CSM should explain all observed data in the field to the extent possible and data that are not incorporated into the model, even if qualified, should be thoughtfully considered. Conceptual and numerical models that best fit available data are critical for technical defensibility of the application of the model to evaluate flow paths and contaminant fate. The CSM for LNAPL transport needs to more broadly consider potential rates, directions and distances of LNAPL transport and the primary features and processes affecting that potential transport. The Navy should present the Regulatory Agencies with an approach for developing modeling of

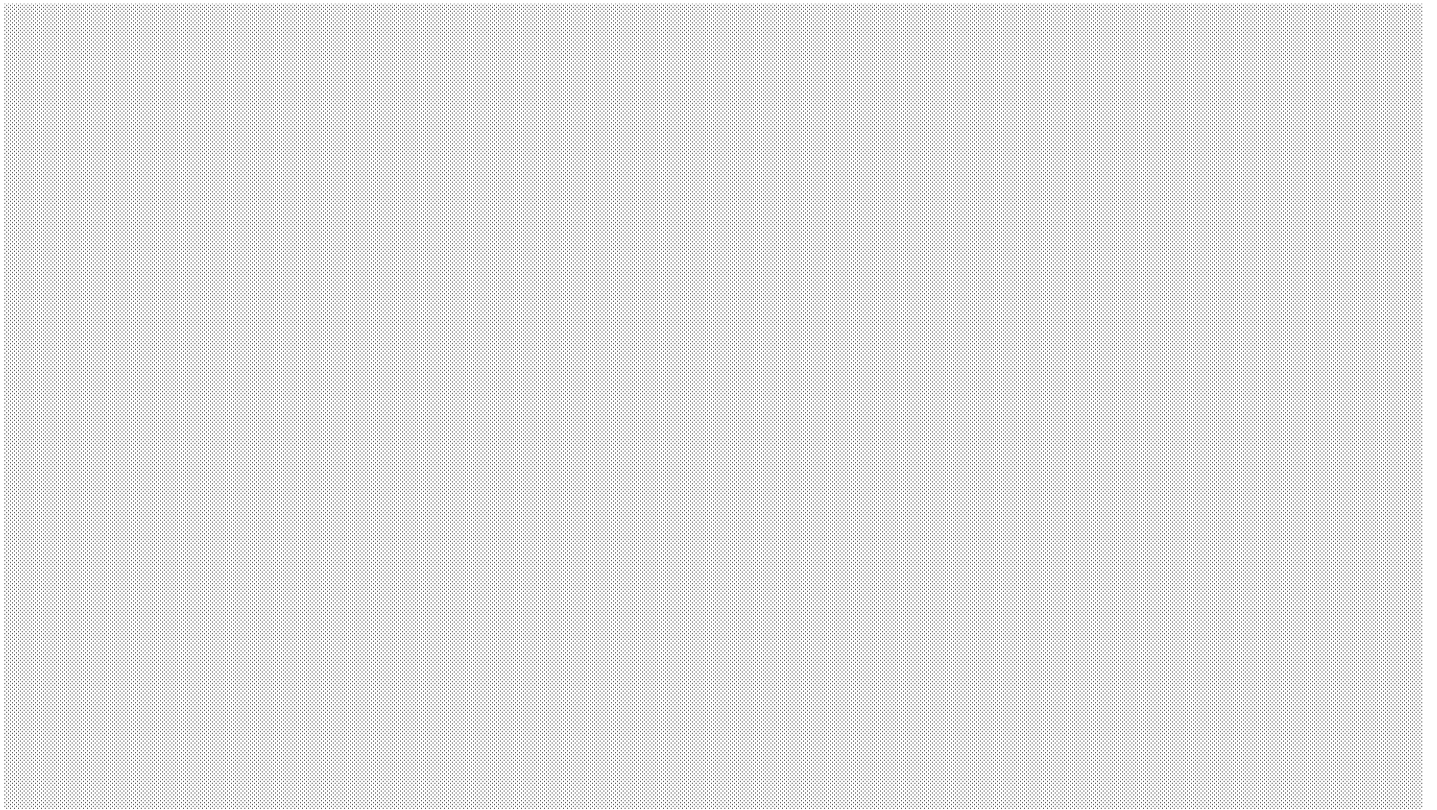
Preferential pathways- The consideration and methods of incorporation of preferential pathways in both the CSM and the groundwater model are unclear. Although it is impracticable to precisely characterize these features, the influence that geologic structures, such as voids, fractures, lava tubes, and the permeable interface between lava flows, have on contaminant and groundwater transport should be explained conceptually in the CSM. The influence of these structures should also be incorporated into the GFM using appropriate and traceable mathematical representations. This directly impacts the Navy's ability to evaluate contaminant transport in the vadose zone and in the groundwater.



LNAPL fate and transport in this environmental setting. The final model should consider potential rates and directions of transport as a function of different types of releases, provide source terms to determine if releases can be captured through pumping, model cumulative effects of releases over time, and utilize incoming field results and new information to calibrate model outputs to observed conditions.

The Navy's current CSM and statistical Non-Aqueous Phase Liquid ("NAPL") holding model do not adequately address potential impacts to groundwater from fuel releases, account for Light Non-Aqueous Phase Liquid ("LNAPL") migration processes, or explain lines of evidence for historical transport observed in the field. Although local characterization data indicates that substantial natural attenuation of hydrocarbons may be occurring, field characterization of the subsurface is highly challenging and impractical in some areas near and around the tanks at the Facility. Therefore, conservative assumptions bounding NAPL fate and transport or robust, dynamic fate and transport models are critical for long term environmental stewardship.

Outputs from the GFM do not comport with measured groundwater gradients in terms of their magnitude, direction, and variability. Several lines of evidence - including measured water levels, organic and inorganic water quality sampling results - suggest occasional gradients, groundwater flow and contaminant migration toward the northwest from tanks located further up the ridge at the Facility. 6) Calibration to groundwater heads and gradients- The GFM does not closely reproduce measured heads and gradients. The final model should prioritize use of the best available groundwater level data reflecting the range of hydraulic gradients under reasonable pumping and non-pumping conditions.



Comments on Environmental Work 4/22/2019
and Development of the
Contaminant Fate and Transport
Model for the Red Hill
Administrative Order on Consent
("AOC") Statement of Work ("SOW")

2014 Release Impact to Groundwater: Although the data do not show widespread increases in contaminant levels in groundwater after the 2014 release, the Regulatory Agencies believe there is evidence to suggest that a portion of the 2014 JP8 release may have reached groundwater. First, vapor data indicate possible transport to the northwest outside of the source zone monitoring array. Second, the detection behavior of TPH- diesel and naphthalene at RHMW02 suggests that either dissolved-phase entrainment of petroleum or fuel-related migration to the water table may have occurred near this well. Available data show that the 2014 release did not cause relatable increases in petroleum detections at Red Hill Shaft.

Total Petroleum Hydrocarbons ("TPH") and TPH Related Analyte Detections: At Red Hill, TPH is often the most frequently detected group of compounds and provides interpretive utility. The analytic data set was prepared by certified labs using appropriate and accepted procedures, and, with some exceptions, the reported values are considered valid. TPH is an indication of petroleum impacts in groundwater, and as discussed in DOH guidance documents (HDOH, 20121, HDOH 2012c2, HDOH 20163), the risk posed by dissolved-phase petroleum in groundwater can be informed by the range of TPH in addition to individual analytes such as benzene and naphthalene. While the Regulatory Agencies acknowledge that variance in the detection of TPH arises from many factors, including analytical method and differences between laboratories, the variance alone does not negate the value of the data and the pattern of repeated detections. Lab precision in TPH quantification does not imply that TPH detections are false positives: rather, there are other potential explanations for the observed distributions and behavior of TPH.

Light Non-Aqueous Phase Liquid ("LNAPL") Presence: Persistent detections of TPH and individual fuel constituents in groundwater are typically interpreted to result from the presence of an LNAPL source. Due to the frequency of elevated detections in RHMW01, RHMW02, and RHMW03, along with the occurrence of occasional detections in distal wells, the Regulatory Agencies conclude it is reasonable to assume that residual LNAPL is present in the subsurface from past releases. Furthermore, despite consensus on the anticipated dilution rates caused at Red Hill Shaft, trace levels of petroleum compounds have been detected in approximately 12% of the samples collected there.⁴ The Regulatory Agencies interpret this information as implying that Red Hill Shaft is a likely receptor, and that some LNAPL mass from the facility may be the cause of those detections. For the Red Hill groundwater system, dissolved-phase fuel impacts are not expected to travel further than approximately 200-ft from the LNAPL source mass, suggesting a relative distance of LNAPL distribution away from the tank farm. This 200-foot estimate is based on Red Hill characteristics reported by the Navy is consistent with plume dimension studies.⁶ However, dissolved phase impacts have been detected further than 200 feet from the tank farm, thus atypical transport conditions, such as fast-track transport features (open voids, lava tubes), may also contribute to the detections observed at Red Hill Shaft.

To be useful, models - whether conceptual or numerical representations of groundwater flow and contaminant fate and transport - must incorporate site and area conditions to reasonably explain or simulate observed data, such as hydraulic responses to stresses or the patterns of detection of contaminants following releases. The Navy's groundwater data is of generally good quality, but at the present time is relatively sparse. Given the highly complex subsurface conditions and a low density of monitoring wells at the Red Hill underground tank farm, the Regulatory Agencies will conservatively interpret data to ensure protection of human health and the environment. Although we agree with much of the Navy's interpretations, we continue to believe that the relatively sparse data available at present can also support the following interpretations:

1. Fuel-related detections reported in distal groundwater monitoring wells are potentially associated with releases from the tank farm;
2. Persistent, elevated concentrations of petroleum related contaminants in groundwater and soil vapor at the tank farm are consistent with the presence of a residual fuel source in the formation; and
3. Some fraction of the fuel released in 2014 may have reached groundwater, with the remainder retained as residual in the vadose zone and subject to natural attenuation processes.

Comments on Vadose Zone 7/1/2019
Modeling for the Red Hill
Administrative Order on Consent
Consent ("AOC") Statement of Work
("SOW")

The Navy has recently proposed using a homogeneous LNAPL Equivalent Porous Media ("EPM") model to simulate how releases, like the 2014 release from Tank 5, move in the vadose zone around the Facility. The Regulatory Agencies believe an EPM model can potentially facilitate a general understanding of how releases from the Facility will tend to move in environments like those found at Red Hill. This information may help refine the Navy's Conceptual Site Model ("CSM"), articulate the possible fate of the 2014 release given the available data, and improve a generalized understanding of the subsurface. However, the Navy should provide a technical rationale for employing an EPM model to support its application in this case, if it will be incorporated into the CSM submitted to the Regulatory Agencies. Ultimately, all modeling efforts under section 7.2 of the Red Hill AOC SOW will need to carefully incorporate or conservatively account for site heterogeneity

Because the proposed LNAPL model does not adequately account for the role of preferential pathways as a conduit for the migration of potential future releases to sensitive receptors, uncertainty related to the role of preferential pathways should be weighed heavily during risk-based decision making. Appropriate engineered and/or institutional controls are likely necessary to account for the uncertainty.

Neither the holding model nor the proposed EPM model can identify preferential pathways or determine their effect on the transport of product through the vadose zone, but an EPM model is generally more representative than the holding model for simulating the consequences of future releases because it incorporates more of the surrounding environment's physical properties. The Navy's proposed EPM model should provide insights for the Investigation and Remediation of Releases Report and the CSM, however it will not provide conservative inputs to the saturated zone contaminant fate and transport model. Satisfactory inputs for the saturated zone model should be developed after further technical discussion with the Regulatory Agencies. As stated in the Red Hill AOC SOW, the contaminant fate and transport model report will utilize the groundwater flow model to improve understanding of the potential for contaminant fate and transport in groundwater.

